

TITLE: STUDY OF THE ACTIVATION OF COAL CHARs

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ABSTRACT

OBJECTIVE

Coal is an important feedstock for preparation of some activated carbon products. The literature shows much interest in development of further high value added products from coals. One of the difficulties in this field is that it is highly empirical. Attempts to introduce a new feedstock or new activation condition require a great deal of experimental investigation, since no reliable predictive models of the processes are yet available. This is attributable to the complexity of the processes involved in preparation of activated carbons. There are two basic characteristics that determine the properties of activated carbons. One is the nature of its porosity and the second is the nature of the carbon surface. This proposal is concerned only with the first. The development of porosity during combustion, gasification, or activation is a problem of great fundamental importance, beyond the general area of application interest in this proposal. Many studies have been conducted by researchers in the combustion and gasification field, but these generally did not involve a detailed enough characterization of the chars for present purposes. Several models have been developed to describe the development of porosity with burn-off, but none has addressed issues related to different porosity development in different activation media. There is clearly a need for a much more detailed study of the development of porosity during the activation of coal char in various gases. This proposal seeks to address this gap in our knowledge, with a comprehensive experimental program.

The proposed approach involves the use of a combination of adsorption techniques which are now accepted by the activated carbon community as providing reliable characterization of the porosity of carbons. This will involve combined use of nitrogen and carbon dioxide adsorptives. In the proposed program of study, the activation of the Argonne Premium coal set will be examined as a function of pyrolysis conditions (temperature and heating rate), mineral content, and activation conditions (gaseous environment, temperature). The activating gases which will be examined include oxygen, carbon dioxide, nitric oxide, and steam. The intent is to develop a clearer understanding of how the above factors influence development of porosity with burn-off. It is also proposed that a study be conducted into when the micropores are accessible to activating agents and when not. This will employ a chemisorption-based technique.

ACCOMPLISHMENTS TO DATE

The program actually began only during the present academic year, and the results obtained to date are therefore rather limited. A large data set is already available, describing the development of porosity in various chars and the role that catalytic minerals play in determining the development of porosity on the micropore level. It is clear that in certain cases, the development of porosity occurs via two distinct pathways in what amounts to an almost competitive manner.

PLANS FOR THE UPCOMING YEAR

The project is still in its very early stages. Data are being acquired, but have not yet been fully analyzed. This is clearly an activity which is ongoing and will continue for the next academic year. All of the Argonne coals will be evaluated, with respect to porosity development. Some particular attention will be paid to the special behavior under high pressure combustion and gasification conditions. In addition, the effects of partial demineralization will be explored. Existing models of porosity development will be critically evaluated in the context of these new data.

ARTICLES AND PRESENTATIONS, AND STUDENTS RECEIVING SUPPORT

No articles have been prepared as yet, since the project only got underway this academic year.

Students Supported on this Grant

Mr. David Deutsch

Ms. Melissa Callejo (summer, 2000)

Mr. Allan Vragar (expected in the fall of 2000)